DTV
DIGITAL TELEVISION

What Every Consumer Should Know

Federal Communications Commission
Media Bureau and Consumer & Governmental Affairs Bureau
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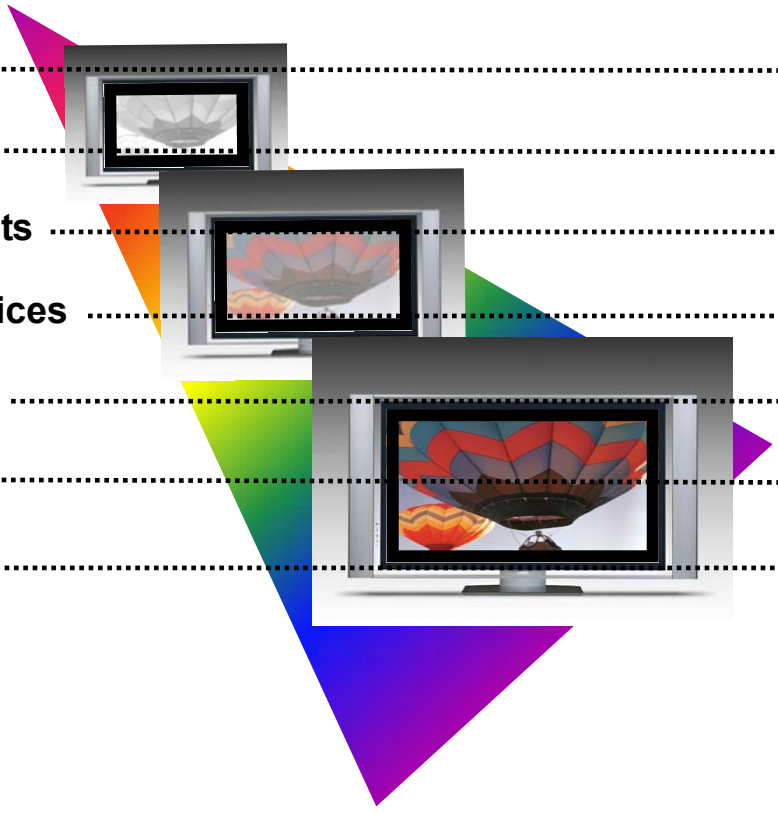

DTV: Digital Television

DTV is a new type of broadcasting technology that will transform television. Because DTV is delivered digitally, the television signal is virtually free of interference. And because DTV is more efficient than analog, broadcasters are able to offer television with movie-quality pictures and surround sound. Ultimately, DTV will replace today's analog television broadcasting system.

This booklet has been prepared by the Federal Communications Commission (FCC) to help you better understand and answer many of your questions about the transition to digital television.

DTV is virtually free of interference.

DTV Why Now?

In the late 1990s, Congress determined that broadcast stations must transition from analog television broadcasting to digital television broadcasting. Converting to DTV will free up parts ("bands") of the scarce and valuable broadcast spectrum, allowing these bands to be used for public safety and emergency services and new wireless services. Because public safety and emergency services have become even more important today, Congress recently established a "hard" DTV transition deadline that requires all full-power television stations to cease analog broadcasts after February 17, 2009. (The deadline for low power television and translator stations will be established at a future date.) Until then, most television stations will continue broadcasting on both their digital and analog channels. Already today, more than **1,500 television stations** servicing markets throughout the United States are delivering television programming in digital format.

DTV Programming

Digital television offers many advantages over analog television for viewing broadcast signals. DTV is more versatile and efficient than analog television and allows stations to broadcast more programming using less spectrum. In the same bandwidth that a broadcaster currently provides one analog channel, a broadcaster may provide a super sharp "high definition" (HD) program or multiple "standard definition" DTV programs simultaneously. Providing several program streams in one broadcast signal is called "multicasting." A broadcaster also can use its DTV signal to provide video and data services that are not possible with analog technology.

Television stations serving every market in the United States are currently delivering digital television programming. For a list of available digital programming, visit **http://www.dtv.gov/partners.html**.

DTV and Your Analog TV

Today, most people have analog televisions.

Analog TVs have been used since the beginning of television to receive and display programming. Your analog television will work as it does today until the transition to digital is completed. Even then, you will be able to continue using your analog television.

DTV is revolutionizing the TV industry.

Analog televisions will work with a digital television set-top box.

If you receive TV programming over the air, you will be able to purchase a **set-top box** (sometimes referred to as a digital-to-analog converter box) to enable your analog TV to continue working after February 17, 2009. Beginning in 2008, your household may be able to receive up to two coupons worth $40 each toward the purchase of set-top boxes. The National Telecommunications and Information Administration (NTIA) has responsibility for administering the coupon program, and will issue rules regarding the coupons in the future. Additional information can be found at http://www.ntia.doc.gov/.

If you are a cable or satellite customer, you may need a set-top box to receive DTV signals and convert them into the format of your current analog television, even after the DTV transition is complete. A DTV set-top box also may receive multicast channels and high definition programming and display them in analog picture quality. Check with your cable or satellite provider to determine if and when you will need a set-top box.

DTV uses the same antennas as analog TV.

If you already have a good VHF and UHF antenna, either indoors or on your roof, you don't have to buy an antenna that is "HD Ready." DTV broadcasters have been assigned channels in the VHF and UHF bands, between 54 and 700 MHz, where analog channels 2 to 51 are now. Therefore, as long as a DTV signal is available, your existing antenna should still work after the transition is complete.

DTV takes advantage of your home theater surround sound.

Analog television broadcasts sound just like FM stereo radio. DTV broadcasts are digital and allow many more options, including Dolby® Digital 5.1 Surround Sound, just like a DVD. With a DTV set-top box, the digital surround sound will be converted to analog for your current television. If you have a home theater system, a set-top box will allow you to enjoy the benefits of digital sound even with an analog television.

DTV Equipment

The DTV transition has two parts. Broadcasters must upgrade to digital transmission, and viewers of over-the-air TV must upgrade to digital reception.

Even with a set-top box, your current analog television will not be capable of taking full advantage of DTV. To enjoy the full picture quality and benefits of DTV, you may want to purchase a new DTV set. But before you do, there are a few things to consider.

A digital display may be an integrated television or just a monitor.

"Integrated" or all-in-one DTV sets have built-in tuners to receive over-the-air DTV broadcasts and a screen to display the programming. Other than a standard antenna, you don't need any other equipment to receive DTV.

The FCC has adopted rules that require all digital TVs sold in the United States to include a DTV tuner. Today, all TVs with a screen size of 25 inches or larger are required to have a DTV tuner. By March 1, 2007, all TVs sold in the United States, regardless of screen size, must incorporate a DTV tuner.

A **"Monitor"** does not have a built-in tuner and requires you to obtain a separate receiver (e.g., a set-top box) to receive and view digital programming. DTV set-top boxes can be purchased at retail stores. Cable and satellite providers also sell or lease set-top boxes for their specific services.

A digital television may be digital cable ready (DCR).

Cable subscribers may want to consider a digital cable ready ("plug-and-play") DTV set. These sets have the circuitry of a digital cable box built in. With a CableCARD, a security card that DCR TV owners obtain from their cable company, scrambled programming such as premium services may be viewed without a set-top box. Current DCR sets are for one-way programming only. While the consumer electronics and the cable television industries are working on a two-way agreement, cable subscribers will need a set-top box from their cable provider for two-way services like video-on-demand and pay-per-view programming. Most major TV set manufacturers produce DCR sets and HD sets with built-in digital tuners. Not all TV sets with built-in digital tuners are DCR.

A CableCARD

Digital televisions will work with existing components.

DVD players, camcorders, VCRs, and video game consoles ("peripherals") will work with your new DTV. Many DTVs and digital-ready TVs have video inputs which take advantage of their higher display capabilities, such as DVI or Firewire (see "DTV Definitions" - pg. 10). Virtually all DTVs also retain composite video inputs (for peripherals) and antenna inputs (for receiving over-the-air TV signals). When using non-high definition peripherals, DTVs either display the lower resolution or use signal processing to upconvert the image to HD. Digital video recorders (DVRs) also work with DTV, but you will need a DVR that is HD capable to record HD.

DTV Formats—Aspect Ratio

Televisions come in two aspect ratios. These ratios are 4x3 and 16x9. The aspect ratio is the comparison of the screen's width to its height. Traditional analog TV has a 4x3 aspect ratio. This means that a TV screen is 4 inches wide for every 3 inches of height. Many new digital televisions are 16x9, or "widescreen." The 16x9 aspect ratio more closely approximates the look of movies, and broadcasters have begun offering programming that takes advantage of it.

"Letterbox" is the term used when 16x9 content is viewed on a 4x3 screen. In order to display the widescreen content without distortion or missing parts of the picture, the television will place black bars at the top and bottom of the image.

"Pillar box" is the term used when 4x3 content is viewed on a 16x9 screen. In order to display the squarer traditional picture on a widescreen monitor, black bars are placed down the sides of the screen.

"Postage stamp" is the term used when a 4x3 transmission contains widescreen images and its own letterbox bars. When viewed on a television, the image will appear as a smaller box within your screen.

DTV Formats—Resolution

Although there are as many as 18 DTV formats, only 4 formats are commonly used. The most common formats fall into three broad categories:

High Definition TV (HDTV)

HDTV in widescreen provides the highest resolution and picture quality of all DTV formats. A current analog TV picture is made up of 480 horizontal lines. An HDTV picture can have up to 1080 lines, allowing for sharp picture detail. The most common formats are 720p ("p" stands for progressive scan - see "DTV Definitions," pg.11) and 1080i ("i" stands for interlaced - see "DTV Definitions," pg.11) with either 720 progressively (non-interlaced) scanned lines or 1080 interlaced lines. Combined with digitally-enhanced sound technology, HDTV achieves a new benchmark for sound and picture quality in television.

Enhanced Definition TV (EDTV)

EDTV is a step up from analog TV and SDTV. Also called 480 progressive (480p), EDTV is widescreen 16x9 or traditional 4x3 format and provides better picture quality than SDTV, but not as good as HDTV. Most DVDs are encoded as 480p (which means they are not available in high definition, yet).

Standard Definition TV (SDTV)

SDTV is the baseline display and resolution for both analog and digital. Transmission of SDTV is usually in the traditional 4x3 aspect ratio, but may be wide-screen 16x9 format. SDTV and analog TV can deliver up to 480 interlaced (480i) resolution, although analog TV may be lower.

DTV Sizes & Costs

DTV sets have wider, more rectangular screens.

As with analog televisions, DTV set sizes range from very small to quite large. All TV sizes are measured diagonally across the screen. So, most DTV sets, which have an aspect ratio of 16x9, are wider, but shorter, than analog TV sets of the same screen size.

As with any new consumer electronics technology, DTV sets have become less expensive since their introduction. Prices vary depending on screen size, display technology, whether a DTV tuner is built-in, and other features. While DTV sets are still more expensive than their analog counterparts, prices have dropped dramatically.

DTV Screen Choices

You'll have a number of different screen choices when you look at DTVs. Some of the most common are:

Cathode Ray Tube (CRT) screens - These are traditional color television screens updated for digital. Their resolution and color capabilities vary from model to model. These screens have a very bright picture, but are limited in size; the units are typically quite heavy.

Rear Projection TVs - Rear projection TVs can be much larger than standard CRTs. They create the image on a small display, but then enlarge it onto the back of the screen. Older model rear projection TVs using small CRTs to create the image were dim and hard to see from extreme angles, but new digital projection technologies like Liquid Crystal Display (LCD), Digital Light Processing (DLP), and Liquid Crystal on Silicon (LCoS) create brilliant, wide-angle pictures on ever-larger screens.

Front Projectors - Projectors are TVs that create an image by projecting onto a wall or stand-alone screen (much like a movie theater). Projectors use the same digital projection technologies as rear projection TVs but, because the screen is separate, the image can be the size of an entire wall. Projectors are not as bright and often require the room to be dark in order to clearly see the image.

Flat Panel TVs - Flat Panel TVs are very thin and relatively light weight and are sometimes hung on the wall. Current flat panels use either LCD or plasma screen technology. Flat panel LCDs are very thin and produce extremely clear pictures. Plasma screen TVs produce images by lighting small pockets of colored gas. This technology allows the TV to create a bright, clear picture in large screen sizes while remaining only a few inches thick.

DTV At A Glance

Analog TV

- Analog broadcasts may continue through February 17, 2009.
- Analog receivers currently built into virtually every TV. Single program stream, no advanced services.
- Will continue to work with cable, satellite, VCRs, DVD players, camcorders, video games, and other devices.
- Provides good pictures but with interference and noise.
- Up to 480 interlaced lines of resolution.
- 4x3 aspect ratio.
- FM stereo sound.
- Can receive only analog TV. A set-top box is needed to receive DTV.

Digital TV

- Digital broadcasts are available now in every market. After the digital transition is completed, over-the-air television will only be broadcast in digital format.
- With an integrated DTV set, only an antenna is needed to receive over-the-air DTV broadcast programming. For a monitor or analog TV, a DTV set-top box is required.
- Multicasting, electronic program guide, data streaming, and high definition available.
- Will work with cable, satellite, VCRs, DVD players, camcorders, video games, and other devices. Images will not be displayed in HDTV unless the equipment is made for it.

SDTV
Standard Definition DTV

- Provides good pictures without interference.
- 480 interlaced lines of resolution.
- 4x3 or 16x9 aspect ratio.
- Multi-channel digital surround sound, including Dolby® Digital 5.1.
- Can receive both digital and analog TV. No set-top box needed if tuner built-in.

EDTV
Enhanced Definition DTV

- Provides better picture resolution, clarity, and color.
- At least 480 progressive lines of resolution.
- 4x3 or 16x9 aspect ratio.
- Multi-channel digital surround sound, including Dolby® Digital 5.1.
- Can receive both digital and analog TV. No set-top box needed if tuner built-in.

HDTV
High Definition DTV

- Provides best available picture resolution, clarity, and color.
- Up to 1080 lines of resolution - most common formats are 720p (progressive) and1080i (interlaced).
- 4x3 or 16x9 aspect ratio.
- Multi-channel digital surround sound, including Dolby® Digital 5.1.
- Can receive both digital and analog TV. No set-top box needed if tuner built-in.

www.dtv.gov www.dtv.gov www.dtv.gov www.dtv.gov

DTV Definitions

Analog TV: Today's TV system that uses radio frequency (RF) waves to transmit and display pictures and sound.

Aspect ratio: Screen's width as compared to its height. For example, for 4x3, the traditional TV aspect ratio, a 32-inch TV would be 25½ inches wide and 19 inches tall. A 16x9 ***widescreen*** 32-inch TV is closer to a movie screen than a traditional TV, and would be 28 inches wide and 16 inches tall.

Broadcast Digital-to-Analog Converter Box: A stand-alone device that receives and converts digital signals into a format for display on an analog television receiver.

CableCARD: Security card that ***digital cable ready*** TV owners must obtain from their cable company in order to view scrambled programming such as premium services.

Cathode Ray Tube (CRT) Screens: Traditional color television screens are available for both ***analog*** and ***digital TV***. Their resolution and scanning vary from model to model. These screens have a very bright picture, but are limited in size and are quite heavy.

***Closed Captioning*:** Service that allows persons with hearing disabilities to read dialogue, or the audio portion of a video, film, or other presentation, on the TV screen.

Coaxial: Coaxial inputs (sometimes just called "cable") provide a simple and common way to transmit video. Now coaxial inputs are mostly used for connecting a TV set to an antenna or cable system.

Component Video*:** Also known as "Y Pb Pr," this connector splits the video signal into three parts. With two audio connections, this 5 wire solution is the most common way to connect EDTVs to DVD players and most HDTV ***monitors to their receivers or other set-top boxes.

Composite Video*:** Also called "RCA" connectors, it is the most common way to connect peripherals and other components. It consists of one yellow connector for video and two audio connectors for "right" and "left". Composite connectors cannot transmit high definition pictures, so for HDTV, another connector option, such as ***HDMI or ***Component Video,*** must be used.

***Digital Broadcast Satellite (DBS)*:** TV programming delivered via high-powered satellite. Signals are transmitted to a small dish (usually 18 - 24 inches across) mounted outside.

Digital Cable Ready TV (DCR)*:** Also referred to as ***"plug-and-play," this is a DTV or other device for digital cable customers that plugs directly into the cable jack, and does not require a separate set-top box to view analog and unscrambled digital cable. Used with a CableCARD, it can receive scrambled programming such as premium services.

***Digital TV (DTV)*:** Digital technology television that uses radio frequency (RF) to transmit computer code and display it as pictures and sound.

Dolby® Digital: Form of multi-channel digital sound, it provides efficient encoding and noise reduction for high quality surround sound.

Downconvert: Process by which a high resolution signal is reduced to a lower resolution for display. Usually, extra lines are simply ignored when drawing the lower resolution image, but sometimes more sophisticated methods are used.

DVI: Digital Video Interface (DVI) is a high quality digital connector. Similar to ***HDMI*** *(see definition)* and sometimes with ***HDCP*** *(see definition)*, DVI can digitally transmit uncompressed high definition video, preserving perfect picture quality. Unlike ***HDMI*** or ***Firewire*** *(see definition)*, DVI requires a separate audio connection.

Enhanced Definition TV (EDTV): Better digital television transmission than ***SDTV*** with at least 480p (progressive), in a 16x9 or 4x3 display and Dolby® digital surround sound. 480p is the quality of most progressive scan DVDs and players.

EPG: Electronic Program Guide (EPG) is an interactive list of upcoming TV programming that can be transmitted along with a DTV program.

Flat Panel TVs: Flat Panel TVs are very thin, lightweight TVs that are often hung on the wall. Current flat panels use either Liquid Crystal Display (LCD) or plasma screen technology.

Firewire: See ***IEEE 1394***.

Front Projectors: TVs that create the image on a small display, then enlarge it by projecting it onto a wall or stand-alone screen (much like a movie theater). Front projectors tend to be dimmer than direct flat panels or CRTs, and often require the room to be dark to be able to see the image clearly.

HDCP: High Definition Content Protection, a technology used to prevent piracy of high quality uncompressed video, primarily over ***DVI*** connections.

HDMI: High Definition Multimedia Interface, a high quality digital connector. Similar to ***DVI*** and sometimes with ***HDCP***, HDMI can digitally transmit uncompressed high definition video and audio on the same cable, preserving picture and sound quality.

High Definition TV (HDTV): The highest quality digital television, generally ***widescreen*** 16x9 with at least 720 ***progressive*** lines or 1080 ***interlaced*** lines and surround sound.

HDTV Built-In (also Integrated HDTV): HDTV set with the tuner built into the set. It does not need a separate set-top box to receive over-the-air signals.

HDTV Monitor (also HDTV Ready): TV set with the inputs and capability to become an HDTV with the addition of an HDTV tuner, HD cable set-top box, or HD satellite receiver.

HDTV Tuner (also known as decoder or receiver): Device capable of receiving and decoding HDTV signals. HDTV tuners can either be built into a TV set (see ***HDTV Built-In***) or be a stand-alone device (see ***Set-Top Box***).

IEEE 1394: Also called Firewire or I-link, IEEE 1394 is a way to transmit compressed data and video between components on one cable.

Interference: Unwanted electrical signals or noise causing degradation of reception on a communications circuit.

Interlace Scan: Way to scan vertical lines onto a TV picture by scanning all the odd lines first, then filling in the even lines. (This happens in the blink of an eye.)

Letterbox: Blank bars above and below the image when viewing 16x9 aspect ratio content on a 4x3 screen. The opposite of ***pillar box.***

Multicasting: DTV technology that allows each digital broadcast station to split its digital bandwidth into two or more individual channels of programming and/or data services. (For example, on channel 7, you could watch subchannel 7-1, 7-2, 7-3 or 7-4.)

Multi-Channel Digital Sound: Feature of DTV that permits numerous streams of sound to be transmitted for a given program, providing stereo, surround sound, and even other languages.

Native Resolution: Specific resolution that a television, whether or not integrated, or a monitor, is designed to display. All other resolutions must be either upconverted or downconverted for display.

Pan-and-Scan: Alternative to ***letterboxing***, the process by which a 16x9 image is converted for display on a 4x3 television by zooming in on the picture and panning to the part of the image that is most interesting. This allows the image to fill the entire screen, but causes some portions of the image not to be displayed.

Pillar Box: Blank bars to the left and the right of an image when viewing 4x3 aspect ratio content on a 16x9 screen. The opposite of ***letterbox***.

Pixel: Smallest area of a television picture capable of being sampled and transmitted through a system, and displayed on a monitor.

Plug-and-Play: See ***Digital Cable Ready (DCR).***

Postage Stamp: Occurs when an image is both letter and pillar boxed. When viewed on a television, the image will appear as a smaller box within your screen.

Progressive Scan: Way to scan vertical lines onto a TV picture by scanning all the lines consecutively (progressively). At the same number of lines, progressive scan produces a higher quality picture than ***interlace scan***. All flat panel and many digital projection televisions are progressive scan, so they display progressive scan images more clearly compared to interlaced images.

Pulldown, 3-2: Process by which a movie shot in 24 frames per second (fps) is shown as an interlaced television image at 30 frames per second.

RCA Connectors: See ***Composite Video.***

Rear Projection TVs: Potentially much larger than standard CRT TVs, rear projection TVs create an image on a small display, then enlarge it onto the back of the screen. Old rear projection TVs used a small CRT, while new digital projection TVs use LCD (Liquid Crystal Display), DLP (Digital Light Processing), or LCoS (Liquid Crystal on Silicon) to create brilliant, wide angle pictures.

Resolution: Amount of detail that can be seen in a broadcast image. For television, resolution is measured in horizontal lines displayed (commonly 480, 720, or 1080).

Set-Top Box: A stand-alone device that receives and decodes programming so that it may be displayed on a television. Set-top boxes may be used to receive broadcast, cable, and satellite programming.

Spectrum: Range of electromagnetic radio frequencies used in the transmission of radio, data, and video.

Standard Definition TV (SDTV): Basic digital television format closest to traditional analog TV.

Ultra High Frequency (UHF): Part of the radio spectrum from 300 to 3000 megahertz which includes TV channels 14-69. After the DTV transition, UHF TV will be changed to 470 to 698 MHz, which includes channels 14-51.

Upconvert: Process by which a digital, high definition television takes a lower definition picture and converts it into a higher definition picture. This may be done by doubling each line as it is drawn on the screen, or by using advanced algorithms to interpolate the data between each lower resolution line, filling in the missing image.

Very High Frequency (VHF): Part of the radio spectrum from 30 to 300 megahertz, which includes TV Channels 2-13, and the FM broadcast band.

Widescreen: Term used generally to describe an aspect ratio wider than 4x3. For television, refers to the 16x9 aspect ratio.

Yagi Antenna: Type of antenna, generally designed for UHF frequencies, that is ideal for receiving most DTV stations. Ranging in size from several inches to many feet, a yagi antenna is the most common design for roof-top antennas.

For More Information on DTV

Go to www.dtv.gov

or

Contact the FCC's

Consumer & Governmental Affairs Bureau

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